

IB 103LF: Invertebrate Zoology

Course Instructor TBD

Graduate Student Instructors TBD

COURSE DESCRIPTION AND GOALS

Invertebrate zoology includes the biology of all animal organisms that do not have vertebrae, which means more than 95% of all described species of animals. This 5-credit course includes 3h of lecture and 6h of laboratory section per week. Lectures will concentrate on organizing and interpreting information about invertebrates to illustrate (1) evolutionary relationships within and among taxa, (2) morphology, reproduction, development and physiology of major phyla, and (3) adaptations that permit species to inhabit particular environments. Laboratories will be a hands-on opportunity for you to learn about the structure and function of the major invertebrate body plans; and field trips will bring all information together, with living examples.

My primary objective in this course is to present the invertebrate diversity that has evolved on Earth (at least of the ones we are aware of); not in depth, but with an overview and selected highlights. By the end of the course you should be able to (1) identify major invertebrate phyla and the morphological characters that define them; (2) apply basic concepts of zoological classification and interpret phylogenetic trees; and (3) discuss current hypotheses for the origin of major invertebrate groups and the relationships among them. Along with introducing you to the diversity and evolution of animal body plans, my goal is also (4) to develop your written and oral communication skills. I also hope you will teach and learn from one another, especially when studying course materials and completing laboratory exercises.

ASSIGNMENTS AND GRADING

The final grade will be scaled according to course units: 60% for lecture (3 units) and 40% for laboratory (2 units) assignments.

Lecture grade break down

70% - Written exams: two midterms worth 20% each and one cumulative final exam worth 30% of the grade. The exam dates are noted on the course syllabus. Each exam will consist of two sections: short answers (definitions of terms), labeling, matching questions, and 3-4 comprehensive essay questions (compare and contrast the following...; discuss the relationship between...; discuss the adaptive significance of...). **The exams will draw on information from the lectures, laboratory exercises, and field trips.**

20% - Research paper: each student will choose a topic for further study. Topics may be similar but work is individual. We will provide a list with suggestions. This paper should be 4–5 pages long (not including references; 12-point font size, line spacing 2.0, margins 1", pdf format). You should cite at least 10 references and at least 80% these should be from peer-reviewed journals. This paper should not just be a review of what has been published, but it should also include your opinion about the issues that have been raised as well as questions that you think could be asked/answered in the shortcoming future. Guidance will be provided during the lab section.

10% - Oral presentation: oral presentations will be held during the lab section. The presentation should be done in 12–15 min and may use any technology source available in the classroom (*e.g.*, chalkboard, multimedia projector, audio system). You must come to one of my office hours on the week prior to your presentation to show me what you have prepared. Guidance will be provided during the lab section.

Lab grade break down

40% - Notebook: includes 30% lab activities and 10% aquarium log. The primary goal of the lab sections is to give you hands-on experience observing invertebrates. The lab notebook will consist of detailed, labeled drawings of all organisms and notes on behavior of live organisms made during each lab period. You may have photos in addition to, but not in place of, the drawings. It will also be a log of your fieldtrips and aquarium observations. Lab notebooks will be collected regularly and graded. Grading will be based on the overall quality of the notebook, specifically the care and thoroughness of the drawings and labels, the thought evident in the notes, and the overall accuracy and thoroughness of the lab, fieldtrips and aquarium descriptions. More details will be provided in the first lab section.

You do not need to be an artist to have top-notch notebook. Simple sketches and diagrams are more efficient than artistically rendered illustrations. This notebook will be your most valuable product of the course. Draw what you see, record carefully and in detail, draw big and simple pictures, use the microscope to see details (remember to record the magnification), and talk to your neighbors about what you are seeing. Usually each individual finds a different part of the organism interesting!

The aquarium log will be based on your observation of behavior and interactions among organisms, and also notes on aquarium maintenance (for example, measurements of salinity, pH and temperature, and animal care). We expect you to respect the animals and taking care of them will be your responsibility.

30% - Field trips and CalDay: there will be four mandatory field trips, three field trips during your regular lab section and a full-day Sunday field trip on **22.Apr.2018**. These field trips are integral parts of the class and attendance is expected. You are also expected to participate at the IB exposition during

CalDay for 2 hours on **21.Apr.2018**. 20% of the grade will be attendance on field trip and CalDay and 10% will be for assigned for active participation during these events. On weeks with fieldtrips you will be notified in advance of appropriate gear to bring. Make sure you dress appropriately! We will carpool to local sites. Fieldtrips will be held in all weather conditions.

30% - Quizzes (Lab practicum): four 20 min practical exams with organisms that you have seen in lab. There will be a combination of labeling, matching, fill in the blanks and multiple choice questions.

COURSE POLICIES

Attendance: this class is very hands-on and your attendance is required. More than two absences to lab sections will be considered as failure unless you present a valid medical reason. Please be punctual.

Grades will be assigned on a straight scale: 90% -100% of the total points = A; 80%-89% = B; 70%-79% = C; 60%-69% = D; 59% or lower = F.

Office hours: I encourage you to make use of our office hours. The amount of information introduced in this course makes it easy to get behind. If you even begin to feel overwhelmed, do not hesitate to get help.

Late assignments and Make-up exams: the research paper should be sent by the deadline. For each late day, 25% will be deducted from your final grade on the paper. Make-up exams should be avoided and requests will be considered on a case by case basis. If a problem arises, notify me immediately. Make-up exams will be in oral format.

Re-grade policy: please feel comfortable to consult me if you believe the grading of your assignments was not fair. You will have 24h after receiving the exam to request a regrade. Be ready to explain your reasoning.

Dissection: Dissection is an integral part of this class. We will dissect different invertebrate groups such as clams, worms and crabs. Any concerns should be brought to my attention as soon as possible.

Accommodations: Contact me as soon as possible if you need disability-related accommodations in this class or if you are a student athlete and expect to miss any lectures, labs or fieldtrips. If you are a DSP student, give me a Letter of Accommodation from the Disabled Students' Program office at the beginning of the semester.

Inclusion statement: I embrace human diversity and will not tolerate any kind of prejudice. Please be mindful, respect your peers and help me create a safe learning environment for all.

Academic integrity: academic dishonesty and plagiarism will not be tolerated. Please be honest and produce original work. The internet is a great source of information; however, you will learn nothing by copying and pasting such information on your assignments. You will find that paraphrasing helps you verify your understanding. Please review UC Berkeley's academic integrity policies at: <http://sa.berkeley.edu/conduct/integrity>.

WEEK	COURSE SCHEDULE AND CONTENT		
1	Wed, Jan 17 th	What is Invertebrate Zoology about?	
	Fri, Jan 19 th	History of life on Earth and the origin of the Metazoan	Chs 1, 5 (187-194, 201-206)
Mon, Jan 22 nd			
2	Wed, Jan 24 th	Systematics: taxonomy, classification and phylogeny	Ch 2
	Fri, Jan 26 th	Assembling the Tree of Life	Ch 28
3	Mon, Jan 29 st	Metazoan development and the bauplan concept	Chs 4, 5 (183-187, 197-201)
	Wed, Jan 31 st	Porifera and Placozoa APPROVED RESEARCH THEME DUE BY 5 PM	Ch 6
	Fri, Feb 2 nd	Ctenophora and Cnidaria	Chs 7, 8
4	Mon, Feb 5 th	Bilateria/Triploblasts: Xenacoelomorpha, Protostomes (Chaetognatha, Spiralia and Ecdysozoa) and Deuterostomes	Chs 5 (195-196, 206-209), 9, 11 (420-428)
	Wed, Feb 7 th	Spiralia I: Chaetognatha, Platyhelminthes and some enigmatic spiralians	Chs 10, 11 (414-420; 428-432), 15
	Fri, Feb 9 th		
5	Mon, Feb 12 th	Spiralia II: Annelida and Nemertea	Chs 12, 14
	Wed, Feb 14 th	Spiralia III: Mollusca	Ch 13
	Fri, Feb 16 th		
6	Mon, Feb 19 th	HOLIDAY	
	Wed, Feb 21 st	Spiralia IV: Gnathifera and Lophophorata	Chs 16, 17
	Fri, Feb 23 th	MIDTERM 1 (50 minutes; up to Feb 16th)	
7	Mon, Feb 26 th	Recap and beyond: Spiralia Comparative Zoology	
	Wed, Feb 28 th	Ecdysozoa I: Nematoida and Scalidophora	Chs 18, 19
	Fri, Mar 2 nd	Ecdysozoa II: Panarthropoda – Tardigrada, Onychophora and Arthropoda	Ch 20
8	Mon, Mar 5 th	Arthropoda – Myriapoda and Chelicerata	Ch 23, 24
	Wed, Mar 7 th	Arthropoda – Trilobita and Crustacea	Ch 21
	Fri, Mar 9 th	Arthropoda – Crustacea and Hexapoda	Ch 21, 22
9	Mon, Mar 12 th	Arthropoda – Hexapoda (Kipling Will, ESPM)	Ch 22
	Wed, Mar 14 th	Evolution of Development: bauplans go awry (Nipam Patel, IB)	
	Fri, Mar 16 th	Evolution of Development: bauplans go awry (Nipam Patel, IB)	
10	Mon, Mar 19 th	Recap and beyond: Ecdysozoa Comparative Zoology	
	Wed, Mar 21 st	MIDTERM 2 (50 minutes; Feb 21st–Mar 19th)	

	Fri, Mar 23 rd	Research paper OUTLINE (just a brainstorm; max. 1 page; send by midnight)	
	Mar 26 th –30 th	SPRING BREAK	
11	Mon, Apr 2 nd	Evolution of flight in insects (Robert Dudley, IB)	
	Wed, Apr 4 th	Deuterostomia I: The Echinoderms	Ch 25
	Fri, Apr 6 th	Behavior in stomatopods and cephalopods (Roy Caldwell, IB)	
12	Mon, Apr 9 th	Deuterostomia II: Hemichordata and Chordata	Chs 26, 27
	Wed, Apr 11 th	Deuterostomia: Body function	
	Fri, Apr 13 th	Kelp forest communities (Tim Herrlinger, IB)	
13	Mon, Apr 16 th	How larvae of benthic invertebrates swim and settle in turbulent ambient water flow (Mimi Koehl, IB)	
	Wed, Apr 18 th	Marine and terrestrial herbivory (Rosemary Romero & Jun Ying Lim, IB)	
	Fri, Apr 20 th	Intertidal community ecology (Wayne Sousa, IB)	
		RESEARCH PAPER DUE BY 7 PM	
	Sat, Apr 21 st	CalDay	
	Sun, Apr 22 nd	Fieldtrip to Monterey and Monterey Bay Aquarium (LT: -0.5, 11:07 am)	
14	Mon, Apr 23 rd	Extinctions and ecological opportunities (Seth Finnegan, IB)	
	Wed, Apr 25 th	Recap and beyond: Metazoa Comparative Zoology	
	Fri, Apr 27 th	Metazoan phylogeny: what are the big questions?	
	Apr 30–May 4	RRR WEEK	
	May 9th (Wed) 3–6 pm	FINAL EXAM (Wheeler 120)	

* Let me know if you are using the second edition of the book and I will provide the correspondent chapters.

* Dates and topics are tentative!

Textbook

Brusca, R.C. & Moore, W. & Shuster, S.M. 2016. *Invertebrates*, 3rd ed. Sunderland, MA: Sinauer Associates. There is a copy of the textbook on reserve at the Biosciences library (in VLSB).

Supporting Literature

Primary literature will be posted on bCourses.

Cracraft, J. & Donoghue, M.J. 2004. *Assembling the tree of life*. Oxford, UK: Oxford University Press.

Maddison, D.R. & Schulz, K-S. 2007. *The tree of life web project*. <http://tolweb.org>.

Nielsen, C. 2012. *Animal evolution. Interrelationships of the living phyla*, 3rd ed. Oxford, UK: Oxford University Press.

Ruppert, E.E.; Fox, R.S. & Barnes, R.B. 2004. *Invertebrate Zoology, a functional evolutionary approach*, 7th ed. Belmont, CA: Brooks Cole Thomson.

LABORATORY SCHEDULE AND CONTENT

Week		LAB themes and activities
1	W/Th (17-18 Jan)	NO LAB
2	M/T (22-23 Jan)	Lab Intro; animal diversity; protists
	W/Th (24-25 Jan)	Phylogeny and Tree-Thinking; aquarium tour & set up (Gaby Keeler-May)
3	M/T (29-30 Jan)	Bauplan and development; using identification keys
	W/Th (31-1 Feb)	Porifera; literature review and scientific writing
4	M/T (5-6 Feb)	Cnidaria and Ctenophora
	W/Th (7-8 Feb)	Platyhelminthes and enigmatic spiralian
5	M/T (12-13 Feb)	Field trip: Berkeley Marina (LT: -0.1, 4:30 pm & -0.22, 5 pm)
	W/Th (14-15 Feb)	Quiz 1; Annelida, Nemertea and Rotifera
6	M/T (19-20 Feb)	NO LAB
	W/Th (21-22 Feb)	Mollusca
7	M/T (26-27 Feb)	Mollusca, Lophophorata and Gnathifera
	W/Th (28-1 Mar)	Field trip: SF Marina Green (LT: -0.98, 4:30 pm & -0.88, 5:13 pm)
8	M/T (5-6 Mar)	Nematoda, Tardigrada, Onychophora, Myriapoda and terrestrial Chelicerata
	W/Th (7-8 Mar)	Quiz 2; Trilobita, marine Chelicerata and Crustacea
9	M/T (12-13 Mar)	Crustacea and Hexapoda; Essig Museum Tour (Peter Oboyski)
	W/Th (14-15 Mar)	Hexapoda
10	M/T (19-20 Mar)	Arthropoda
	W/Th (21-22 Mar)	Field trip: Botanical Garden (freshwater and terrestrial system)
SPRING BREAK		
11	M/T (2-3 Apr)	Quiz 3; Comparative Zoology I
	W/Th (4-5 Apr)	Echinodermata
12	M/T (9-10 Apr)	Echinodermata, Hemichordata and Chordata
	W/Th (11-12 Apr)	Comparative Zoology II
13	M/T (16-17 Apr)	Quiz 4; species identifications; tips for outstanding oral presentations
	W/Th (18-19 Apr)	Student presentations
14	M/T (23-24 Apr)	Student presentations; UCMP Tour (Erica Clites)
	W/Th (25-26 Apr)	Student presentations; Review

- Dates and topics are tentative!